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SRK
Steffen Robertson and Kirsten
Consulting Engineers and Scientists

1755 East Plumb Lane
Suite 244
Reno, Nevada 89502
(702) 786-3225
FAX (702) 786-4435

FAX TRANSMITTAL

To: Tom Munson - Coeur
Number of pages: 5 (Including Cover)
Fax Number: (801) 359-3940
Project Number: [illegible]
From: Jeff Parshley
Date: 3/13/97
Subject: Cracked Mtn. Tailings Pile Analysis

MARCH 13, 1997
FINES PILE
WATERSHED
ANALYSIS

- BLOCKING DRAINAGE NORTH OF PROPOSED UNDERSIZE MATERIAL

Hard copy to follow? Y___ N___
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STEFFEN ROBERTSON AND KIRSTEN (U.S.), INC.
7175 West Jefferson Avenue, Suite 3000
Lakewood, Colorado 80235

Phone: (303) 985-1333
Fax: (303) 985-9947

FAX TRANSMITTAL FORM

TO: JEFF PARSHLEY DATE: 3/13/97

FAX NO: SRK-RENO PAGE 1 OF 5 (including this page)

FROM: PETE KOWALEWSKI PROJECT NO: 57705

SUBJECT: CRICKET MTN

JEFF- FOLLOWING IS THE REVISED MEMO, SORRY FOR THE CONFUSION... LET ME KNOW IF YOU NEED ANY ADDITIONAL INFO OR IF YOU WANT ORIGINALS SENT. THANKS.

-PETE

HARD COPY TO FOLLOW?
☐ Yes ☒ No

MEMORANDUM

TO: Jeff Parshley, SRK - Reno

FROM: Pete Kowalewski, SRK - Denver

DATE: March 13, 1997

SUBJECT: **Effect of Blocking Drainage North of Proposed Undersized Material Stockpile at Continental Lime's Cricket Mountain Facility (SRK #57705)**

1.0 INTRODUCTION

The proposed Undersized Material Stockpile at Continental Lime's Cricket Mountain Facility will be constructed in a manner to prevent the stockpile material from blocking the drainage adjacent to the facility at the northern portion of the facility. The drainage located to the north of the facility conveys runoff from upstream catchment areas to downstream receiving waters. The catchment areas upstream of the Undersized Material Stockpile contain in excess of 750 acres of both disturbed and non-disturbed lands.

A proposal has been made to regrade the north-facing slopes of the Undersized Material Stockpile during closure activities at the Cricket Mountain site. The regrading of the "fine" rockfill (minus $^{3}/_{16}$") will block the drainage currently located adjacent to the northern portion of the proposed facility. Upon blocking the drainage, flow will accumulate behind the blockage and will either pass through the "fine" rockfill or it will impound behind the blockage until containment is lost and the water flows around the Undersized Material Stockpile.

Rates of runoff from upstream catchment areas were determined for the runoff due to the 100-year 24-hour storm event at the Cricket Mountain site (2.8 inches). The computer program, HEC-1 (U.S. Army Corps of Engineers, 1991), was used to evaluate runoff quantities, routing relationships, and to perform a storage-routing analysis at the blockage in the stream channel caused by the regrading of the stockpile.

The flow through the 'fine" rockfill was evaluated using a method presented by Leps (1970). If incoming flows from the upstream catchment areas are greater than the quantity of flow conveyed through the rockfill, water will accumulate behind the blockage.

2.0 DETERMINATION OF FLOW THROUGH ROCKFILL

Flow through rockfill was determined using the following equation presented by Leps (1970):

$$V_V = Wm^{0.5}i^{0.54}$$

where:
- V_V = average flow velocity in voids; in/sec
- W = empirical constant for rockfill dependent upon shape and roughness of rock particles
- m = hydraulic mean radius
- i = hydraulic gradient

Flow rate (per unit area of rockfill) was determined using the continuity equation:

$$q = V_V * A_V$$

where:
- q = flow through unit area of rockfill; cfs/ft^2
- V_V = average flow velocity in voids; ft/sec
- A_V = area of voids (surface area * porosity); ft^2

The flow rate through the "fine" (minus $^3/_{16}$") rockfill was determined to be 0.0557 cfs/ft^2 (see attached calculation sheets). The calculated flow rate through the "fine" rockfill should be interpreted as an upper bound on the actual flow through the rockfill due to the fact that the calculation for flow was based on a homogeneous fill with particles having a diameter of $^3/_{16}$-inch. In reality, the "fine" rockfill will be a graded material which will contain particles having smaller diameters, which will reduce the porosity and average pore diameter of the rockfill. The reduction of both of these values will significantly reduce the ability of the rockfill to transmit flow.

3.0 CONCLUSIONS

The routing study performed by HEC-1 showed that the blockage created by the regrading of the Undersized Material Stockpile will not be able to convey the peak inflow (112 cfs) from upstream catchment areas due to the 100-year 24-hour storm event. As a result, water will impound behind the blockage until its depth reaches approximately 5 to 10 feet in depth (depending upon topography of surrounding area). When the impounded water depth increases to an elevation greater than the surrounding topography, flow will commence around the blockage in addition to through the blockage. Flow through the blockage will be at a rate comparable to the flow rate calculated in Section 2.0, while flow around the facility will concentrate along the toe of the regraded Undersized Material Stockpile.

The flow of excess runoff around the toe of the regraded stockpile could pose a significant risk with respect to the overall stability of the stockpile. As the flow concentrates at the toe of the facility, the fine-grained material in the stockpile will be susceptible to erosion. As the stockpile erodes at the toe, material may slump in the side slopes, leading to further erosion of the stockpile.

The HEC-1 analysis of the drainage basin containing the Undersized Material Stockpile was conservative in the fact that flows from the catchment area upgradient of Overburden Disposal Area #1 and runoff flows from Overburden Disposal Area #1 were not included in the analysis. Even without the inclusion of these flows, the analysis clearly shows water will be impounded behind the blockage created by regrading the stockpile. The impounding of water will lead to water flowing around the regraded stockpile, which in turn will lead to erosion of the stockpile slopes.

STEFFEN ROBERTSON & KIRSTEN
Consulting Engineers & Scientists

PROJECT: CRICKET MOUNTAIN	NO. 57705
CALCULATED BY: PEC	DATE: 3/12/97
CHECKED BY:	DATE:
SHEET 1 OF 1	

COMPARISON OF FLOW THROUGH COARSE ROCKFILL AND "FINE" ROCKFILL.

BASED ON PREVIOUS WORK BY SRK (MEMO PK → JP 12/2/96) FLOW THROUGH COARSE ROCKFILL IN UPPER PORTION OF WASTE ROCK DISPOSAL AREA #1 AT CRICKET MOUNTAIN IS ESTIMATED TO BE 0.182 CFS/FT^2 OF ROCKFILL (GRADIENT = 13.33%)

$q_{ROCKFILL} = 0.182 \text{ CFS/FT}^2$

ASSUMING POROSITY (n) = 0.40

$V_{ROCKFILL\ VOIDS} = 0.455 \text{ FT/SEC} = \underline{5.46 \text{ IN/SEC}}$

CALCULATE FLOW THROUGH -3/16" BACKFILL

ASSUME BACKFILL IS HOMOGENEOUS (ALL PARTICLES 3/16" DIAMETER) [CONSERVATIVE ASSUMPTION]

USING SAME GRADIENT AS PREVIOUS CALCULATIONS: ($i = 0.1333$ FT/FT; 13.33%)

(m) HYDRAULIC MEAN RADIUS $\cong$ 0.0225 IN.

(W) EMPIRICAL CONSTANT = 33 (CRUSHED GRAVEL)

USING RELATIONSHIP DEVELOPED BY LEPS

$$V_V = W m^{0.5} i^{0.54}$$

V_V = AVG VELOCITY OF WATER IN VOIDS, IN/SEC

USING VALUES PRESENTED ABOVE,

$$V_V = (33)(0.0225 \text{ IN})^{0.5} (0.1333)^{0.54}$$

$$V_V = \underline{1.67 \text{ IN/SEC}}$$

ASSUMING $n = 0.40$ (CONSERVATIVE - FOR WELL GRADED MATERIAL n WILL REDUCE)

$q_{ROCKFILL} = V_{VOIDS} A_{VOIDS}$

$= (0.1392 \text{ FT/SEC})(0.40)(1 \text{ FT}^2)$

$= 0.0557 \text{ CFS/FT}^2$ - ROCKFILL

$\underline{q_{ROCKFILL} = 0.0557 \text{ CFS/FT}^2 \text{ ROCKFILL}}$